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INCLUSIVE CITIES FOR VISUALLY IMPAIRED PEOPLE

Deborah Macedo dos Santos [1]
Thiago Bessa Pontes [2]
Camila Bandeira Pinheiro Landim [3]

ABSTRACT

Objective: The objective of this study is to to present a literature review and its evolution regarding how elements of city architecture can contribute to the inclusion of the visually impaired and the most appropriate way to reproduce it, specifically in the context of Brazil.

Theoretical Framework: The urban organization of a city can either contribute to or hinder human interactions, social inclusion, and the autonomy of people with disabilities. However, for a long time, cities were not planned to accommodate diversity, becoming even a segregating space for some minorities, such as the visually impaired.

Method: The methodology adopted for this research includes the review and discussion of books, articles, specialized virtual pages, and pertinent legislation.

Results and Discussion: The results obtained revealed that urban orientation elements for the visually impaired lack standardization, making them a hindrance to their perception.

Research Implications: Future work needs to invest in the research for the standardization of tactile maps and floors, also incorporating new technologies.

Originality/Value: This study contributes to the literature by discussing city architecture from the perspective of the visually impaired, highlighting practical contributions for better territorial performance for this specific population.

Keywords: Accessibility, Visually Impaired, City Architecture, Sustainable Cities and Communities.

CIDADES INCLUSIVAS PARA PESSOAS COM DEFICIÊNCIA VISUAL

RESUMO

Objetivo: O objetivo deste estudo é apresentar uma revisão da literatura e sua evolução a respeito de como os elementos da arquitetura da cidade podem contribuir para a inclusão do deficiente visual e qual a maneira mais adequada de reproduzi-lo, no contexto específico do Brasil.

Referencial Teórico: A organização urbana da cidade pode contribuir ou não para as interações humanas, inclusão social e autonomia das pessoas com deficiência. Contudo, durante muito tempo as cidades não foram planejadas para acolher a diversidade, tornando-se até um espaço segregador de algumas minorias, como é o caso dos deficientes visuais.

Método: A metodologia adotada para esta pesquisa compreende a revisão e discussão a partir de livros, artigos, páginas virtuais especializadas e legislação pertinente.

[1] Universidade Federal do Cariri. Juazeiro do Norte, Ceará, Brazil. E-mail: deborah.macedo@gmail.com
Orcid: https://orcid.org/0000-0001-5143-2434
[2] Universidade Federal do Cariri. Juazeiro do Norte, Ceará, Brazil. E-mail: bessa.phd@gmail.com
Orcid: https://orcid.org/0000-0001-7475-8971
[3] Universidade de Fortaleza. Fortaleza, Ceará, Brasil. Faculdade de Arquitetura da Universidade de Lisboa, Lisboa, Portugal. E-mail: camila.bandeira@unifor.br Orcid: https://orcid.org/0009-0000-9800-0794

Resultados e Discussão: Os resultados obtidos revelaram que os elementos de orientação urbana aos deficientes visuais carecem de uma falta de padronização, tornando-se um agente dificultador da percepção deles.

Implicações da Pesquisa: Para trabalhos futuros há a necessidade de investir em pesquisa de padronização dos mapas e pisos táteis, também com o uso das novas tecnologias.

Originalidade/Valor: Este estudo contribui para a literatura ao discutir a arquitetura da cidade na perspectiva dos deficientes visuais, evidenciando contribuições práticas para o melhor desempenho territorial para esta população específica.

Palavras-chave: Acessibilidade, Deficiente Visual, Arquitetura da Cidade, Cidades e Comunidades Sustentáveis.

CIUDADES INCLUSIVAS PARA PERSONAS CON DISCAPACIDAD VISUAL

RESUMEN

Objetivo: El objetivo de este estudio es presentar una revisión de la literatura y su evolución con respecto a cómo los elementos de la arquitectura de la ciudad pueden contribuir a la inclusión de los discapacitados visuales y cuál es la manera más adecuada de reproducirlo, en el contexto específico de Brasil

Marco Teórico: La organización urbana de la ciudad puede contribuir o no a las interacciones humanas, inclusión social y autonomía de las personas con discapacidad. Sin embargo, durante mucho tiempo las ciudades no fueron planificadas para acoger la diversidad, convirtiéndose incluso en un espacio segregador de algunas minorías, como es el caso de los discapacitados visuales.

Método: La metodología adoptada para esta investigación comprende la revisión y discusión a partir de libros, artículos, páginas virtuales especializadas y legislación pertinente.

Resultados y Discusión: Los resultados obtenidos revelaron que los elementos de orientación urbana para los discapacitados visuales carecen de una falta de estandarización, convirtiéndose en un agente dificultador de su percepción.

Implicaciones de la investigación: Para trabajos futuros hay la necesidad de invertir en investigación para la estandarización de mapas y pisos táctiles, también con el uso de las nuevas tecnologías.

Originalidad/Valor: Este estudio contribuye a la literatura al discutir la arquitectura de la ciudad desde la perspectiva de los discapacitados visuales, evidenciando contribuciones prácticas para un mejor desempeño territorial para esta población específica.

Palabras clave: Accesibilidad, Discapacitado Visual, Arquitectura de La Ciudad, Ciudades y Comunidades Sostenibles.

1 INTRODUCTION

Part of this research was previously presented and published at a scientific event in 2018 in Fortaleza (Santos, Pontes & Landim, 2018) and as a chapter in a book (Santos, Pontes & Landim, 2019). After careful review, it was expanded and adapted for publication in this scientific journal.

The city's urban organization may or may not contribute to human interactions, social inclusion and autonomy of people with special needs. However, for a long time cities were not planned to welcome diversity, even becoming a space that segregated some minorities, as is the specific case of people with disabilities.

Amiralian (1997) spoke, in his book, about the daily life of cases of visually impaired people, eventually realizing their relationship with spatiality.

“Joana says that in her city she didn’t do anything, she helped around the house and went out with her brothers.” (Amilarian , p. 119, 1997)

Joana was visually impaired and, like others in her condition, only went out accompanied, as she did not have enough autonomy to live in public spaces, however , with the home environment suited to her needs, she had total autonomy.

It is known that blind people have full cognitive capacity and can naturally make use of public spaces. As long as they are encouraged to do so and that cities are designed in accordance with appropriate accessibility techniques.

“This accessibility must be associated with the urban structure that is established in different contexts so that there is actually the possibility of exercising the right to the city.” (Pereira, 2008).

Perhaps the precursor author of this new philosophical current, which believes in the city, not only as the result of aesthetic work, but as a product of interdisciplinary work with transversal knowledge also sociology, anthropology, geography and other sciences, was the architect Kevin Lynch (1998) who considered the image of the city as the result of perceptions from different senses.

> “Structuring and identifying the environment is a vital activity of every mobile animal. There are many types of orientation used: The visual sensation of color, shape, movement or polarization of light, as well as other senses, such as smell, hearing, touch, kinesthesia, the notion of gravity and perhaps the magnetic or electric fields” (Lynch, p.13, 1960).

Kevyn Lynch (1960) further explains that the image of the city should not be associated simply with its aesthetic and visual aspect, but with the attributes of identity and mental image. In addition to aesthetic pleasure, it also lists as important its meaning and capacity for expression, rhythm, stimuli and choices. Understanding the city's architecture beyond its visual aesthetic aspects is the beginning of understanding how to organize an urban space for those who depend on other senses.

"Architecture is not perceived, by the blind, through the aggregation of data offered by different perceptive moments: as happens with those who can see, there is no bricolage of elements." (Frois, p. 88, 2003)

The city then becomes the relationship between the observer and the observed space. This observer, being visually impaired, can be trained to assimilate spaces and move around independently.

> "Brown notes that blindfolded subjects, who were asked to walk through a maze, initially thought this was an unsolvable problem. Repeating the experiment, some parts of the structure, especially the beginning and end, became more more familiar and took on the character of localities" (Lynch, p. 21, 1960)

The cognitive difference between visually impaired and sighted people is related to the way they move and their spatial perception. Therefore, prior knowledge of spaces can be of great importance for their recognition and understanding. But how to think about these spaces? What already exists in the Brazilian context to help build the autonomy of visually impaired people in urban spaces?

The objective of this study is to present a review of the literature and its evolution regarding how elements of the city's architecture can contribute to the inclusion of the visually impaired and what is the most appropriate way to reproduce it, in the specific context of Brazil.

2 SPATIAL ORGANIZATION AND THE CITY IN THE CONTEXT OF THE VISUALLY IMPAIRED

The philosopher Denis Diderot (1979), wrote in his "Letter on the blind, for the use of those who see", among other things, some questions about the processes that the congenitally blind person pursues to acquire and assimilate knowledge. He was probably the first to worry about how the visually impaired could understand the arts and the world around them.

It is evident in his work that, for the blind, spatial organization and the maintenance of order are precious. Furthermore, he needs everything to be precisely in its place. Diderot (1979) exemplifies this premise when narrating the procedure for visually impaired people when they arrive home:

> "Your first care is to put back into place everything that has been put out of place during the day; and when his wife wakes up, she usually finds the house tidy again. The

> difficulty that blind people have in recovering lost things makes them friends of order" (D iderot, p.97, 1749)

This quote gives clues as to how organized and standardized the city's architectural space also has to be so that the visually impaired feel welcomed and have autonomy. Understanding how the blind perceive people can be the best way to design a more inclusive and accessible city architecture.

"This accessibility must be associated with the urban structure that is established in different contexts so that there is actually the possibility of exercising the right to the city." (Pereira, 2008)

Still regarding the perception of visually impaired people, it is known that, through sounds, smells and touch, they can distinguish shapes and even appreciate beauty. "He judges beauty by touch" (Diderot, p. 102, 1749). Perceives symmetries, rhythms and shapes.

"Our blind man judges symmetries very well. Symmetry, which is perhaps a case of pure convention for us, is certainly so, in many respects, between a blind man and those who see " (Puls , p.276, 2006)

Identifying beauty is not just a matter for sighted people, in the same way the visually impaired are also able to appreciate the images of the city.

"By virtue of studying by touch the arrangement that we require between the component parts of a whole to call it beautiful, a blind man can make a fair application of the term." (Puls , p.276, 2006)

Therefore, it is up to researchers and designers to study and develop ways of building a more accessible and inclusive city architecture. By understanding the perception, difficulties and assistive elements of this population, architects and urban planners can design cities that promote autonomy, safety and well-being for all their inhabitants, ensuring that visually impaired people can move and interact in the urban environment with the same ease as psychics.

3 HOW TO DESIGN

In order for travel, not just for disabled people, to be carried out, public sidewalks must have dimensions and be organized in such a way that they can ensure the route is accessible.

The architectural and urban design has a lot to contribute in this aspect. Friars can be installed on sidewalk curbs to prevent cars from parking on them, taking possession of pedestrian space; Crosswalks, or safety lanes, can be raised or access ramps can even be

designed to overcome the unevenness; Underground spaces, such as subway stations, can be equipped with elevators and ramps; The tactile floor can be installed on all public routes; etc.

> "In the specific case of people with visual impairment, there are some resources at their disposal that can help with their accessibility. The blind perceive this grandeur through those elements already explained: wind, silence, distribution of sounds, smells, etc. They do not perceive the mountain, but something that imposes itself on the human spirit; they feel it even through the feeling of freedom that the square establishes and that the football stadium does not achieve – even on grass, where freedom of movement is possible, the monotony of its flat topography breaks this feeling of freedom – one has no idea of the approaching the limits of the lawn" (Frois, p. 87, 2003).

FROIS also says that many of the resources necessary for the inclusion of visually impaired people in the city's architecture are simple, such as the use of sound signals, or textures on the floor to help with walking with canes or guide dogs, for example.

> Throughout the interviews, however, it was verified the occurrence of an approach that did not concern the use of unusual techniques or technologies, to expand the field of preceptive action. On the contrary, what happened was the systematic collection of values as old as Vitruvius' theory. (Frois, p. 90-91, 2003)

Some of them are explored below - Walking stick, guide dog, sound signaling, tactile floor, and tactile map - and the way in which some can be integrated into the designed space is discussed. A brief review is also presented regarding the incorporation of new technologies, such as digital guidance systems and mobile applications, which can complement traditional accessibility methods.

3.1 THE CANE

The cane helps guide people with visual impairments by identifying obstacles. The blind man feels his way with the tip of his cane, detecting the information necessary for his movement.

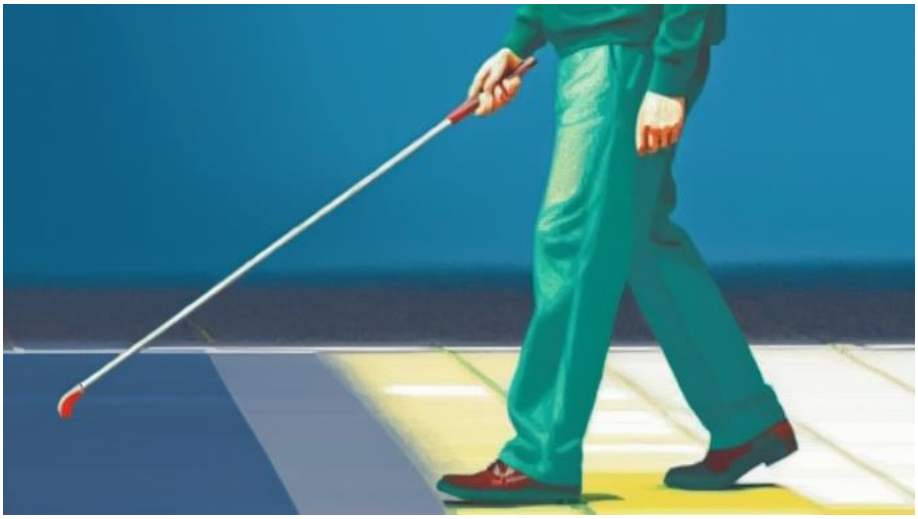
> " Its usage techniques are generally taught by specialized instructors in orientation and mobility courses. To use the cane, one must learn scanning techniques, moving on stairs, touching and sliding the cane, crossing doors and identifying objects such as elevator entrances" (Thesbita , p. 26, 2013).

Since 2019, canes can have four different color patterns – white, green, red with white and green with white – to identify the user's degree of disability. The white cane indicates the person with total lack of vision, the green cane signals the person with low vision, that is, who can identify light and some forms with low definition, the white and red cane signals the deaf-blind person, and the A green and white cane identifies a deaf person with low vision. It should be noted that only the first three color patterns are included in bill 4189 of 2019, approved by the commission for the defense of the rights of people with disabilities in 2021.

In figure 1 you can see an example of a visually impaired person moving around with the help of a cane.

Figure 1

Visually impaired person traveling with the aid of a cane



Source: Own authorship, developed with AI.

Although this instrument is widely used, it alone is not enough, especially when the city does not have the necessary signaling resources, such as directional and warning tactile floors.

3.2 GUIDE DOG

The guide dog (Figure 2) is an animal trained to guide visually impaired people, helping to identify obstacles and paths. However, as dogs do not distinguish colors, they may have difficulty interpreting information such as a traffic light, for example.

Figure 2

Blind person led with the help of a guide dog

Source: Own authorship, developed with AI.

Kevin Lynch (1984), in the book " Good City Form " lists some subsidies that are important for the inclusion of the visually impaired, the guide dog is one of them.

"Provision free seeing-eye dogs for the blind" (Lynch, p. 199, 1984)

In Brazil, since 2005, environments for private and collective use have been required by law to receive visually impaired people with their guide dogs, expressed by law 11.126/05 of June 27, 2005 (Casa civil, 2005). However, it is still rare to see the use of guide dogs in Brazil by visually impaired people.

3.3 SOUND SIGNALING

Just as the bells in church steeples serve, even in modern times, to signal the beginning of a celebration, sound signaling means allow the transmission of information through auditory resources.

The images of the city are also made of sounds. Urban sounds contain a heuristic value that can reveal not only urban evolution, but also the current way environments are organized..." (Fortuna, p. 21, 1998)

Although few designers take the city's sounds into account, they are one of the main ways for the visually impaired to understand the city's image. Fortuna (1998), author of the

article “Images of the city: sounds and urban social environments”, reports on his “rediscovery” of New York City through its sounds

“The geography of this metropolis (NewYork) was taught to me by a friend – Anísio Correia – who, being blind, made me see how the city can be read and perceived through its landscapes and sound environments” (Fortuna, p. 22 , 1998)

In addition to the “natural” sounds of the city, designers can work on the sound resource for a universal orientation. Examples like this are already common in flight directions at airports, in subway stop directions, and in stations, there are beeps to open and close doors, among others.

In the urban fabric, at some points, there are audible traffic lights that indicate to visually impaired pedestrians the right time to cross the street by means of beeps. However, the use of this resource is still rare.

3.4 TOUCH FLOOR

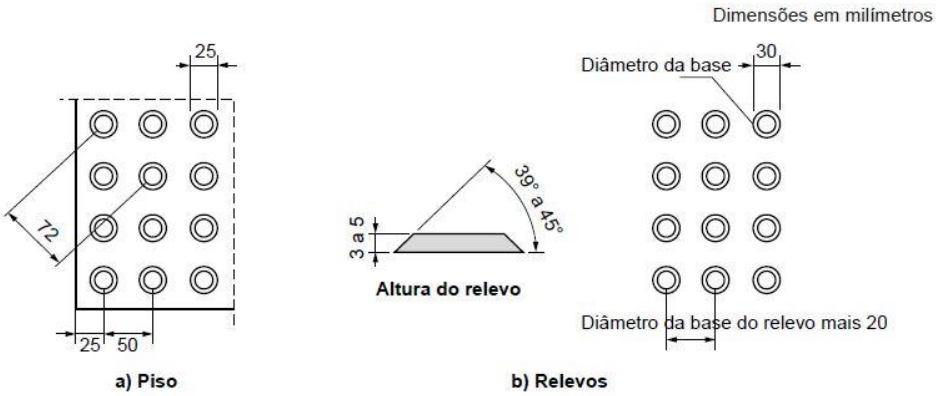
The tactile floor is a signage element with reliefs applied to the floor to guide visually impaired people through the use of a cane and also the sensitivity of their feet.

> “People with visual impairment usually guide themselves with the help of a stick and perceive changes in environments through contact with the floor and walls, due to their texture and relief. The tactile floor is used as a reference to facilitate the orientation of blind and low-vision people and provide them with greater safety and autonomy.” Camisão, p.190, 2010

There are only two tactile floor relief patterns: alert and directional. The first (Figure 03) is made up of plates with a circular texture and serves to indicate that there is a suspended obstacle, a lowered sidewalk, the beginning or end of a sidewalk, doors, unevenness or even that there is a change of direction on the route.

Figure 3

Tactile warning signs and tactile reliefs installed on the floor

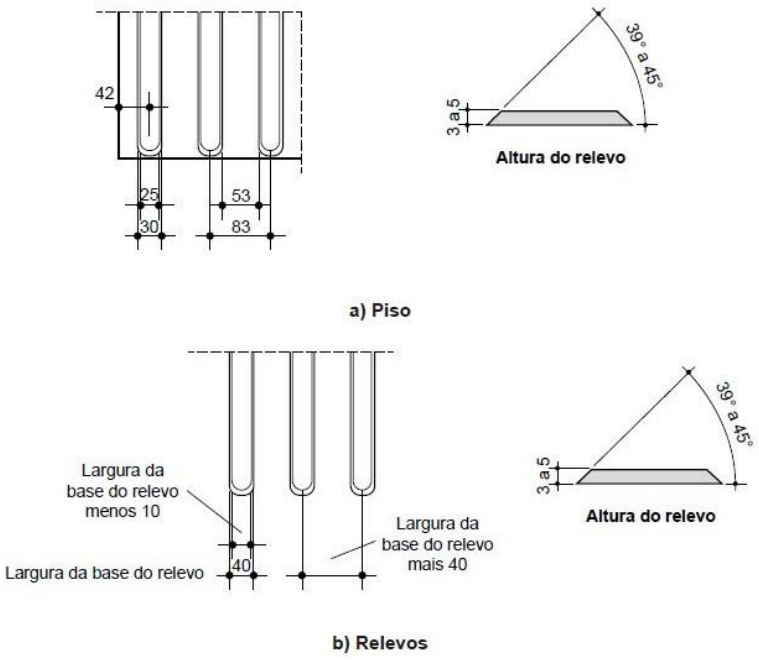


Source: ABNT, 2015

The second pattern (Figure 04) concerns the directional floor. It is made up of plates with the texture of regularly arranged linear bars. The continuous linear texture serves to indicate the direction of possible routes and is marked when used in conjunction with the tactile warning floor.

Figure 4

Directional tactile signage and directional tactile reliefs installed on the floor



Source: ABNT, 2015

> "Tactile floors are strips with a relief surface different from that used on the rest of the local floor, so that it can be perceived more easily by the feet and the cane. On pedestrian

> routes in parks, gardens, squares, sidewalks and large areas, which do not have a curb or line of buildings as a directional reference, a guide (orientation strip) must be allocated to help in perceiving directions. For people with low vision, it is important that the tactile floor is a contrasting color to the surrounding floor, making it easier to perceive. The tactile floor must be carefully allocated in the project and installed, so as not to present bumps or any nuisance to passers-by in general." C amision, p.190, 2010

In figure 5, there is a top view scheme based on the work of architect Maiara Márjore MARINI, which details how the alert (in this case in orange) and directional (in yellow) tactile flooring should be installed at an accessible intersection. It is worth mentioning that in addition to the installation of the tactile floor, inclusive design decisions were also considered, such as a sidewalk with a space greater than 1.50m, an elevated pedestrian crossing, an accessible ramp, corner protection with barriers (planter and trash cans), an exclusive lane for bus, cycle lane, recessed parking spaces.

Figure 5

Project example with tactile floor installation

Source: Based on Marini, 2012, made with the help of AI resources.

3.5 TACTILE MAP

Lynch (1960) describes access to maps and diagrams as a strategy for prior knowledge of environments, and also describes criteria for how they should be prepared for the observer in general.

> "The map, whether accurate or not, must be good enough to guide a person home. It must be sufficiently clear and well integrated to save mental effort: it must be readable. It should be safe, with a surplus of indications so that own initiatives are possible and the risk of failure is not too great." (Lynch, p. 19, 1960).

Still on this strategy of space recognition, Lynch explains that the representation does not necessarily need to be faithful to the original route layout.

> "The beholder can be provided with a symbolic diagram of the way the world harmonizes: a map or a set of written instructions. As long as it can fit into the diagram, it has clues to the relationships of objects. You could even install a machine that indicates directions ... " (Lynch, p. 21, 1960).

This concept was confirmed by engineer Harry Beck in 1933, when drawing the first London subway map, who said that accurately representing geography is not only unnecessary, but can also hide it from the observer's perception.

"Exact geography is not only unnecessary for answering these kinds of questions, it can be even hindering" (Wolf, 2007)

For people with visual impairments, the way to make this resource accessible is by exploring its three-dimensional capacity so that it can be interpreted through tactile resources. This item can be called a map or tactile plan.

> "Maps are graphic representations of space and as abstractions of reality they belong to the world of images. Visually impaired people need these images to be perceived through other channels of perception, replacing vision. A map is called tactile when it is in a format that allows it to be 'seen by touch', in this case, they are constructed through tactile graphic language with raised signs" (Vasconcellos, p. 35, 1993)

The Brazilian association of technical standards defines how tactile maps should be arranged in architectural and urban space:

> "5.4.2.3 These plans and maps must be constructed in a way that allows access, visual and manual reach, complying with Section 4 and 5.4.1-a) . " ABNT, p. 45, 2015

> "5.4.1 - a) the signage must be located within a range of between 1.20 m and 1.60 m in a vertical plane, as shown in Figure 59. When installed between 0.90 m and 1.20 m, it must be on the wall next to side of the handle on an inclined plane between 15° and 30° from the horizontal line and comply with what is described in 5.4.6.5, when it exceeds 0.10 m ; " ABNT, p. 44, 2015

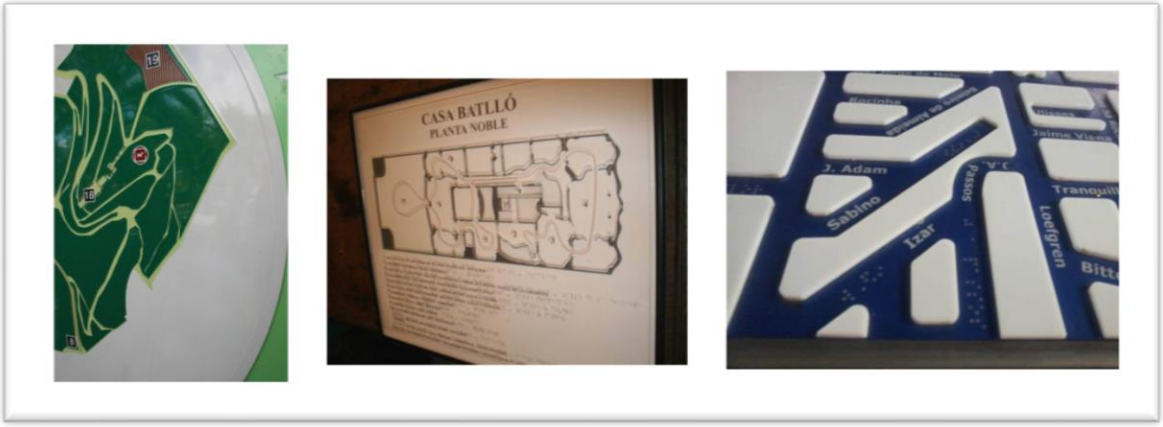
Regarding the preparation, the architect Katakura , tutor of the model office, conducted a survey of several tactile maps in São Paulo and Barcelona and concluded:

> "Evaluating the conditions of the maps installed in Brazil, we found in many of them an artisanal manufacturing process and a great diversity of materials used in their production. Tactile maps in Spain already have standardization, especially when they are created by government bodies. Regarding conservation, the conservation status is adequate in most of the cases analyzed. Regarding resistance to bad weather, no map surveyed in the city of São Paulo shows resistance." Katakura , 2012

The lack of patterns in these maps can make it difficult for visually impaired people to understand the information. In the following figure there are examples of tactile maps cataloged in Katakura 's work (Figure 6).

Figure 6

Examples of public tactile maps



Source: Adapted from Katakura , 2012.

For the future, it is expected that, with the use of new 3D printing technologies, it will be easier to reproduce tactile maps within an internationally adopted standard, using the same materials and same scales. Some research is already carrying out experiments aimed at this solution, such as Celani and Milan (2007) who developed 3D printed tactile maps for mobility in a library in São Paulo.

Sanches *et al.* (2017) found clues in the literature and carried out an experiment where they published, in table form, general recommendations for translating conventional maps into three-dimensional tactile maps. These must be created using 3D printers.

3.6 NEW TECHNOLOGIES

The use of new technologies used to promote accessibility for the visually impaired has been recognized by the nomenclature of assistive technology. These technologies significantly increase users' autonomy and safety, improving their quality of life (Hwang *et al* ., 2020). One example is digital guidance systems that provide real-time location and navigation information through audio. According to the World Health Organization (WHO, 2022), the implementation of these systems in cities can significantly improve the mobility and independence of people with visual impairments.

4 RESULTS AND DISCUSSIONS

This article presented a review of the literature and its evolution regarding how elements of the city's architecture can contribute to the inclusion of the visually impaired and what is the most appropriate way to reproduce them.

Regarding the urban elements discussed that already have standardization and some regulation – tactile flooring, traffic lights with sound signaling – it is clear that their use is not yet common in most public spaces. Regarding the three-dimensional tactile map and new technologies, the lack of standardization of these elements appears to be an agent that hinders the perception of urban space by disabled people.

Although the emission of sound signaling is already standardized, its application at intersections is not constant, so cities are not standardized with the device, hindering the autonomy of people with visual impairments. Regarding tactile flooring, although the design is standardized by ABNT, there is a diversity of materials, non-standard application on sidewalks and a lack of application on many sidewalks. As for tactile maps, this is the element that showed the highest level of destandardization , as standardizing elements have not yet been identified.

For future work, there is a need to invest in research into the standardization of maps and tactile floors, also using new technologies.

5 CONCLUSION

This study makes a significant contribution to the literature by exploring city architecture through the perspective of the visually impaired. It highlights the importance of creating urban spaces that are truly inclusive, facilitating the full participation and autonomy of

this population. The research provides practical evidence and suggestions for improvements in urban planning, such as the need for standardization of wayfinding elements, such as tactile maps and tactile floors, which are crucial for safe and efficient navigation for the visually impaired. Additionally, it emphasizes the incorporation of new technologies, such as digital guidance systems and mobile applications, which can complement traditional methods and provide a more accessible and intuitive experience. This study not only expands academic understanding of urban accessibility, but also offers practical recommendations for urban planners, architects and policymakers, aiming to create more inclusive and sustainable cities that meet the needs of all people, regardless of their visual capabilities.

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